Alloying and Three-Dimensional Composition Profiles of Single Strained Islands

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The electronic properties of self-assembled quantum dots (QDs) are ultimately determined by their atomistic structure or, in a continuum approximation, by their three-dimensional (3D) composition profile. Several techniques have been used to determine the QD composition. Nevertheless, the quantitative measurement of the full 3D composition profile of single QDs is still an open issue.
After discussing the mechanisms leading to alloying during the epitaxial growth of strained islands [1], we show that multi-step selective wet chemical etching, atomic-force-microscopy imaging of the same sample areas and dedicated reconstruction algorithms can be used to obtain quantitative 3D composition profiles of individual QDs and gather statistically significant information to correlate the island composition with its morphology [2]. We apply the method to the SiGe/Si(001) system, which can be considered as a model for understanding the Stranski-Krastanow growth mode and shows remarkable similarities to other QD systems.

[1] U. Denker, A. Rastelli et al. Phys. Rev. Lett. 94, 216103 (2005); M. Stoffel, A. Rastelli et al. Phys. Rev. B 74, 155326 (2006); Phys. Rev. B 75, 113307 (2007)
[2] A. Rastelli et al. Nano Letters, **8,** 1404 (2008).

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